Forming the Nanoparticles of Uranium Dioxide in an Electromagnetic Field

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Producing nanoparticles of refractory compounds with narrow size distribution is one of the complicated problems of nanotechnology. In the present paper the process of forming the nanoparticles of uranium dioxide in an electromagnetic field has been experimentally studied by a laser heating technique. The sample investigated is located in the center of the working chamber filled with inert gas. The sample is heated by powerful laser beam up to high temperatures. The heating curves of the sample have been recorded by a high speed micropyrometer. Spectral reflectivity and emissivity of the sample surface have been measured by the probing flash method. In studying evaporation of uranium dioxide under the laser beam in the chamber filled with inert gas the following features of this process have been discovered: a) the nanoparticles of uranium dioxide were formed above the sample surface in its laser heating due to homogeneous condensation of the evaporating particles from the sample to the inert gas environment; b) size distribution of the nanoparticles depended on the pressure level of inert gas in the chamber, laser beam power and heating zone on the sample; c) the process of forming the nanoparticles was manifested on the heating curves as a sharp drop in sample temperature due to shutter effect of the sample surface by the nanoparticles under the powerful laser beam; d) forming the nanoparticles was exhibited as a threshold process occuring at the temperature which depended on the rate of laser heating and the pressure level of inert gas in the chamber; e) the sizes of the nanoparticles of uranium dioxide were determined by the balance between the processes of homogeneous condensation and evaporation of the nanoparticles under the powerful laser beam. The theoretical model describing the above mentioned features of forming the nanoparticles in the electromagnetic field has been presented.